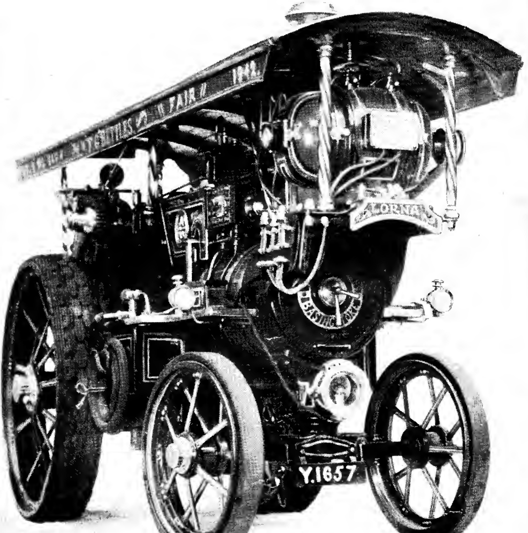
THE MODEL ENGINEER



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The MODEL ENGINEER

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26TH MAY 1949

VOL. 100 NO. 2505

SMOKE RINGS

Our Cover Picture

● WE KNOW that there are hundreds of readers who are keenly, even fervently, interested in steam road locomotives; the many letters on this subject which come to us each week are sufficient evidence of the fact. For our cover picture this week, we have chosen an impressive photograph of a very fine model made by Mr. F. G. Bettles, of Taunton.

This engine has been described and illustrated previously in our pages; it was based on a design of Wallis and Steevens, of Basingstoke, but because Mr. Bettles could not find one of the prototypes anywhere in or around his district, he had to rely upon his memory for details. He wanted to try out some ideas of his own, chief of which was to compare a 2-cylinder high-pressure engine with a double-crank compound. He says that both engines work well, but for model work he prefers the 2-cylinder high-pressure engine, as it is lighter on fuel and water. The exhaust sounds like that of a railway engine, and Mr. Bettles doubts if it would please a showman!

The Proposed Club at Old Oak

● WE ARE very pleased to learn that the proposed model engineering club for Old Oak Common Locomotive Depot, news of which was first published in this column on April 28th, looks like becoming established. Mr. F. Cottam tells us that a meeting will be held in the Fitters' Mess at the Depot at 3 p.m., on Sunday, May 29th. Those who intend to be present should assemble at the Locomotive Shed main entrance, Old Oak Lane, in good time. All railwaymen will be welcome, and we hope the meeting will be successful.

Tell Your Friends

● FOLLOWING UPON our recent comments on the subject of the paper quota, we have been asked by our Publishing Department to pass on the good news that authority has now been granted for a very useful increase in paper consumption to take effect in July and that, in accordance with our forecast, the extra paper will be used in the first instance to provide enough additional copies of "Ours" to ensure that every would-be reader can in future be certain of obtaining regular delivery.

But, please bear in mind that your newsagent can only maintain *regular* supplies if he has your firm order. If you have not already given him an order *do it now.*

We should add that the foregoing applies also to our stable companions *Model Aircraft, The Model Railway News, Model Car News* and *Model Ships and Power Boats,* all of which have hitherto been in short supply.

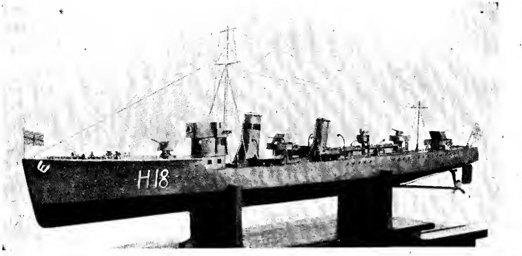
A Model Destroyer

● WE HAVE received a very interesting letter from Mr. F. W. F. Hendry, B.Sc., F.R.I.C., of Chelmsford, describing his model destroyer, accompanied by the excellent photograph which is reproduced on this page. The model represents an Admiralty "S" Class destroyer of 1919, and is to the scale of approximately $\frac{3}{16}$ in. to 1 ft. It measures 52 in. long, $5\frac{1}{8}$ in. beam and $3\frac{3}{4}$ in. draught, the two latter dimensions having been increased to give the extra displacement necessary for a working model. In his letter, Mr. Hendry explains that the hull was carved to templates from a solid block of obeche, the thickness being approximately $\frac{1}{4}$ in. except for the bow, stern and floor. Two bilge keels made of brass are fitted and have proved most effective in stabilising the vessel on the water. The deck is made of thin pine and a portion is removable to give access to the power plant.

The bridge, control platform, chart house and funnels are made up from thin sheet brass, and were built around wooden formers. The guns and torpedo tubes were prepared from various sizes of brass tubing, and the searchlight, from a suitably sized brass nut, filed to shape and fitted with a lens prepared from a piece of glass rod turned in a bunsen flame and cut off with a diamond. It carries a $3\frac{1}{2}$-volt pea-lamp which is wired, via a switch, to the batteries in the hull.

The ship's boats are three in number. These were cut from small blocks of obeche and swung on davits with the appropriate tackle. The ship is driven by a single three-blade propeller of 2 in. diameter and the propeller shaft is connected by means of a flexible coupling to an 8-volt motor which derives its current from two 4-volt boat accumulators. The vessel is finished in naval grey and black, and has a maximum speed of about 4 m.p.h. The photograph is by Mr. C. P. Widdows, of Chelmsford.

We are always pleased to receive descriptions and photographs of their models from our readers.



New Running Facilities

● THE LATEST news from the Brighton and District Society of Model and Experimental Engineers is sure to arouse the interest of many readers. In conjunction with the proprietors of Withdean Zoo, Brighton, the society has been able to lay down 250 ft. of multi-gauge track in the grounds of the zoo. It will accommodate $2\frac{1}{2}$-in., $3\frac{1}{2}$-in. and 5-in. gauge locomotives. In due course, it is hoped to extend the track into a continuous circuit with 90 ft. radius curves.

By Whitsun, a 52-ft. radius model racing car track will probably be available, while later still, a model boating pool will be installed.

The society also has, near-by, the use of a hut in which water, electric light and power are laid on, and there is a flag-pole on which the society's flag, a St. George's Cross with a blue gear-wheel in the centre, proudly flies!

Owners of locomotives, racing cars, power boats and yachts should make a point of taking their models with them when going to Brighton for a day, or even for an extended holiday; for the Brighton society would be only too pleased to give all possible facilities for the running or sailing of the models. Wives and children could, if they so desire, visit the animals in the zoo, or go down to the beach, while fathers enjoy themselves running models! This seems quite a good idea, and any readers who care to take advantage of it are invited to get into touch with the Brighton society's hon. secretary, Mr. H. G. Achard, 48, Aldrington Avenue, Hove, 4, Sussex.

A Club for St. Helens?

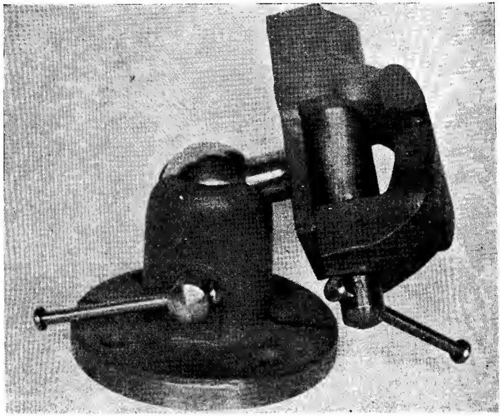
● THE EVER-INCREASING popularity of model engineering as a hobby is reflected in the formation of new societies almost every week. A letter to hand from Mr. J. H. Darley, 15, Robins Lane, St. Helens, Lancs, informs us of a project to form a model engineering society in that town; and if any readers in that area are interested and willing to support such a society, they are invited to communicate with Mr. Darley.

*A Universal Swivelling Vice

by "Ned"

THE two screws for actuating the sliding jaw and clamping the ball swivel respectively, may be made from $\frac{1}{2}$-in. diameter bright mild-steel, and should be turned either between centres, or supported at one end in the chuck, and at the other by the back centre. By using the latter method, the work is held steadier, and the need for a centre at the head end, which importance in the case of the jaw screw than the clamp screw, as the former gets considerably more wear, and any roughness or inaccuracy of form impairs both its durability and efficiency.

After cutting the threads, the screws are reversed in the chuck and the heads neatly rounded off, preferably by facing and roughing out with a slide-rest tool, and finishing with a



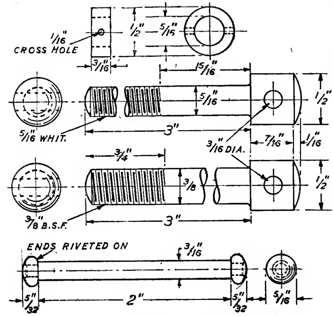
Another view of the finished vice, showing the wide range of angular adjustment obtainable

would be rather unsightly if left in when the screw is finished, is avoided. If the steel is chucked fairly accurately, there will be no need to machine the outer diameter of the head. It is desirable to cut the threads with a single-point tool, if a screwcutting lathe is available, and to finish the thread form with a hand chaser; this is of greater hand tool. The cross hole for the hand lever is then drilled, and in this operation the use of a simple form of cross-drilling jig, as recently described by "Duplex" will be found very helpful in ensuring that the hole is located truly across the diameter. It is advisable to finish the hole with a slightly oversize $\frac{3}{16}$-in. reamer, so that the hand lever is an easy fit.

A collar $\frac{1}{2}$ in. diameter by $\frac{3}{16}$ in. wide is made to press lightly over the shank of the jaw screw

*Continued from page 587, "M.E.," May 12, 1949.

and when the screw has been finally fitted to its bearing in the sliding jaw, it is pinned in position with a $\frac{1}{16}$-in. cross pin. The latter may be either parallel or taper, but in either case precautions should be taken to ensure that it does not work loose, as this might cause jamming of the screw ; slight burring over of the ends of the pin, which should only be just barely proud of the collar at each end, will be sufficient to avoid this risk.



Details of vice screws, hand levers, etc.

The hand levers are made of $\frac{3}{16}$-in. silver-steel, one of the few instances where the use of this steel in structural work is justified, as its resistance to bending is much greater than that of mild-steel. Both ends are turned down to 5/32 in. diameter for a length of $\frac{3}{16}$ in. to receive the end buttons, which are secured by riveting. To make the buttons, a length of $\frac{5}{16}$-in. mild-steel rod is chucked and centrally drilled 5/32 in. diameter, and after partially parting off, at a length of $\frac{1}{8}$ in., they are rounded off with a hand tool, and slightly countersunk at the mouth of the hole, then finally parted off as cleanly as possible, so that no further machining is necessary. The button at one end of the lever is riveted on, holding the shank of the lever firmly between copper clams in the vice, and heading up with light, rapid blows with a small ball pein hammer ; after which the lever is held in the lathe chuck and the end cleaned up with a smooth file, followed by polishing with emery-cloth. Much the same procedure can be followed in fitting the button at the other end, after the lever has been inserted in the cross hole of its screw, but when finishing off the end in the lathe, the shank should be well lubricated, so that it runs freely in the hole, avoiding the risk of seizing up and sending the screw whirling round it. As will be evident from the photographs, the ends of the levers can be finished quite neatly in this way, and the joint of the riveting made practically invisible.

The Loose Nut

The best material for this is tough bronze or gunmetal, and in machining it, the important thing is to ensure that the spigot which fits the baseplate is dead square, with the tapped hole. For this reason, it is advisable to carry out the drilling and tapping first, holding the work in the four-jaw chuck, and taking a facing cut across the front, also centring and drilling as truly as possible before tapping, with a taper tap held in the tailstock chuck. The rear face of the hole can then be machined by mounting the work on a piece of $\frac{5}{16}$-in. Whit. screwed stock held truly in the chuck.

To machine the spigot, the work is then secured to a small angle plate by a bolt through the tapped hole and set to run truly on the faceplate. The spigot should be a close fit in the hole in the soleplate (it is advisable to drill this first as a guide to fitting) and the shoulder of the spigot should be located as exactly as possible $\frac{5}{16}$ in. from the centre of the tapped hole, any error being kept on the minus side.

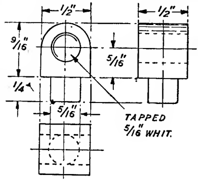
Jaw Inserts

The standard jaw inserts should be made of cast steel, hardened and tempered, though mild-steel, fairly deeply case-hardened, is quite a good substitute, and may be found durable enough for normal use. In many cases, smooth-surfaced inserts will give quite a good grip, and have the advantage that they do not mark the work like serrated jaws ; but if the latter are preferred, do not make the serrations too sharp. Some constructors may prefer to make the inserts from an old file, softened for cutting and drilling, and afterwards rehardened. If this is done, however, the teeth of the file should be completely ground off at the back, and flattened off at the front sufficiently to eliminate the " bite." Harden them in oil, rather than water, to avoid the risks of cracks starting in the interstices of the teeth.

A very useful form of jaw insert is one provided with shallow vees, as shown in the drawing, to facilitate holding round work in either a horizontal or vertical position. The vees may be machined by milling in the lathe, or easier still, by a shaper, if available, and their position should be accurately located so that they are exactly opposed when the inserts are in position. It will be seen that in addition to the single horizontal groove, there is a centre vertical groove for holding short round pieces, and two side

grooves which will deal with longer work passing down the sides of the soleplate. Vee grooves enable round bars to be held very firmly with moderate jaw pressure, and the minimum risk of marring finished surfaces.

The inserts may be held in the vice jaws in the usual way, namely, by countersunk screws tapped into the jaws, but one objection to this practice is that the screw heads occupy an unreasonable proportion of the jaw area, especially in a vice of this size. In some cases, this is reduced by inserting the screws the other way, that is, by drilling the clearance holes in the jaws and counterboring them from the outer ends to take the screw heads, the inserts being tapped for the threaded ends. This practice, however, would not be very easy to carry out without modifying the design of the vice jaws, and the deep counterbores for the screw heads would be rather unsightly.

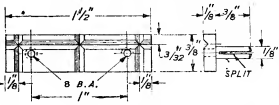


Loose nut

A rather unusual method of holding the inserts in position is suggested in the drawing, and although the constructor, of course, may exercise his option of using the more conventional methods if they are preferred, it will probably be agreed by many readers that the device shown has genuine practical advantages. It consists of equipping each of the inserts with a pair of split plugs, similar to those used for ensuring good contact in electrical fittings, which are made a push fit in plain holes drilled in the vice jaws. The inserts are not positively held in position, though they will obviously be bound to stay in place when work is gripped in the vice, and the plugs provide sufficient friction to keep them in place when the jaws are retracted.

Apart from the fact that the split plugs, inserted from the backs of the insert by either screwing or riveting, take up very little of the face area of the insert, the main advantage of this method is that it enables the inserts to be withdrawn or fitted in a matter of seconds, so that a number of pairs of inserts may be made to suit different purposes, and changed as required. For instance, serrated jaws may be used for general work, plain steel jaws for finished flat work, and vee jaws for round work; while for more delicate work, copper, lead or fibre inserts may be used, and will obviously be much better than sheet material folded over the tops of the jaws, as are most commonly employed with existing vices.

It is desirable to make a simple jig for drilling the holes both in the inserts and the vice jaws, so as to ensure that the locating of the plugs will coincide with the holes, and that in the event of any inserts subsequently made, there will be no difficulty in locating the plugs correctly.



Jaw insert, with vee grooves for holding round stock

Assembly

The soleplate should first be carefully marked out and drilled to take the spigot of the loose nut; this may be located exactly in the centre of the stalk of the ball, by chucking the latter and setting the top face of the soleplate dead square, but this is not vitally essential, as there is no practical reason why the hole must coincide with the ball axis. Four holes are then drilled and countersunk from the underside of the soleplate, to take the screws which hold the fixed jaw.

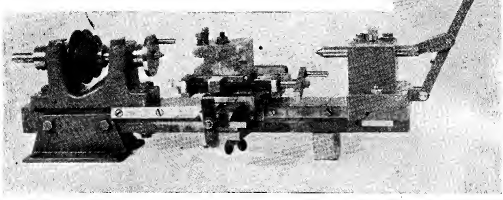
After easing the ram of the sliding jaw (if necessary) to a sliding fit in the tunnel of the fixed jaw, it is inserted in the latter, the screw is also assembled in position, and the nut run on to it, into a position corresponding to what it would be when the jaws are nearly closed. The spigot of the nut is then inserted in its hole, and the jaws thus brought into their normal position on the soleplate, when the fixed jaw can be temporarily clamped in place, and the tapping holes in its underside surface spotted through from the clearance holes in the faceplate. When the screws are fitted, and fully tightened, it may be found desirable to make some adjustment to enable the sliding jaw to move freely but without slackness, by scraping the underside surface of one or the other component, as already described.

It may be thought that the method of holding down the fixed jaw does not provide adequate strength to resist the pressure exerted on the jaws when work is held between them, as the four screws are in shear stress under these conditions. So far, tests have not indicated any lack of strength, however, and it may be observed that much heavier vices than this often have the fixed jaw held by bolts or set-screws similarly stressed. If, however, it is desired to reinforce the strength of the structure, it is possible to fit $\frac{3}{16}$-in. dowel pins between the two screws on each side. The holes to receive them may be drilled and reamed after the jaw is secured in place, and if the dowels are made of silver-steel and closely fitted, they should remove all possible doubts on the shear resistance of the joint. One

(*Continued on page* 635)

Constructing a Small Lathe

by J.K.M.



AFTER the end of the war, the writer again made an attempt to assemble together some sort of workshop, and a review of available equipment showed that all that was left of the pre-war workshop was a small drilling machine, a "Myford" treadle and a kit of hand tools; this was not an extensive kit, but it contained the essentials for carrying out straightforward bench work.

Various jobs were undertaken with this meagre outfit, but the lack of a lathe was very soon keenly felt, and it was decided to make good this deficiency by constructing one. At this time it was very difficult to obtain materials, so a decision was made to use existing scrap as far as possible.

It soon became clear that nothing large or ambitious could be considered, and as more thought was given to the project it seemed obvious that it would be difficult to make even a small, simple lathe without the use of another lathe on which to make some of the most vital parts. How, for example, could a mandrel be made and how could a headstock be bored to the required degree of accuracy? The construction of a tailstock presented similar problems, although it was thought possible to make a slide rest without the use of another machine tool.

It was finally decided that certain machining operations would have to be "put out," but at the same time it was desirable, on the score of expense, to reduce these to the minimum. As it fell out, however, only one operation was, in fact, "sub-contracted" (the machining of the base of the headstock), for half-way through the job the writer gained unexpected access to a large lathe for a limited period, and was thus able to carry out the following essential machining operations:

(1) Turning the headstock mandrel.
(2) Drilling and reaming the headstock bearings.
(3) Turning the cone pulley.
(4) Turning a 60-deg. cone on a piece of ½-in. diameter silver-steel to make the tailstock barrel.

The rest of the job was made at the bench and on the lathe itself when in the partially finished condition.

Within these limiting conditions the lathe was also intended to conform to the following requirements:

(a) It should be capable of turning shafts and spindles up to 8 in. long between centres and up to ⅝ in. diameter.
(b) It should handle chuck work up to ¾ in. diameter and should easily make small parts such as special screws, small pins, knobs, etc., up to about ⅜ in. diameter × 1½ in. long.
(c) It should be reasonably accurate and the aim should be to obtain chuck work with an error of not more than 0.0005 in. on diameter in a length of 2 in.

The finished machine not only satisfied these conditions but surpassed them, and has since led the unenviable life of the small lathe in that it has accomplished work, which should rightly have been done on a machine three times its size.

The photograph shows a front view of the machine and the following is a brief specification:

Centre height 2⅛ in.

Distance between centres 8 in.

Mandrel ⅝ in. diameter, bored hollow to clear ¼ in. diameter. Mandrel nose is ⅝ in. B.S.F. and fitted with Morse taper centre.

Mandrel bearing—cast-iron, split parallel type.

Cone pulley—two steps for ¼-in. diameter belt.

Cross-slide travel 2½ in.

Top-slide travel 2½ in.

The bed, slide rest and tailstock are all built up from steel bar, strip and rod.

The sketches are not offered as working drawings but rather as a ready means of explaining

the mechanical arrangement of the parts, and where dimensions have been added, the aim has been to convey a general idea of size and proportion.

The Bed. Fig. 1

This was made from a length of 1½-in. square bright mild steel. Two pieces of similar material

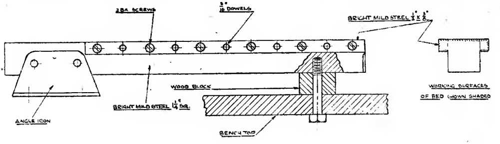


Fig. 1. *Lathe bed*

½ in. × ⅜ in. were dowelled and screwed to this as shown, thus increasing the effective width and also forming "ways" to guide the slide rest and tailstock. The surfaces indicated in the figure were filed and scraped, using a piece of glass as a reference surface and this process, imperfect as it is, can yet produce results which are sufficiently accurate for the purpose. Parallelism of the vertical surfaces was checked by means of a "Unique" test indicator, while the horizontal surfaces were checked at intervals with a micrometer. The bed is supported at the headstock end by two pieces of angle iron, and at the other by means of a single bolt and wooden distance block.

The Headstock. Fig 2

This is an iron casting and, after having the base machined, it was mounted on a faceplate and drilled and reamed for the bearings. These were afterwards split and tapped for an adjusting bolt. The mandrel and screwed nut for end-play adjustment were made from a scrap length of mild steel, but the boring of the mandrel was left until the lathe was practically finished.

The pulley was made from boxwood with a steel centre, the intention being to replace this pulley later with one of aluminium alloy. The original has proved to be quite serviceable, however, and it is doubtful if this will ever be altered. The bearing face contacting the circular nut at the end of the mandrel had to be filed and scraped, since there was neither the time nor the tackle to do this when the bearings were being machined. Each bearing is fitted with a little cycle-hub lubricator. It will be seen that the headstock is bolted down by means of three ¼-in. B.S.F. bolts, the rear bolt forming a pivot by means of which the headstock can be adjusted for alignment with the bed. This work on the headstock, together with the making of the tailstock barrel, constituted the whole of the machining operations used to make the lathe, the remaining components being made by hand. Much disappointment was felt, because a large lathe was only available for a limited period and the work had to be hurried through in a way that

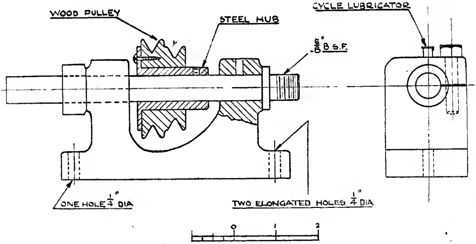


Fig. 2. *Headstock*

was not conducive to accurate results. Particular misgivings were felt, for example, about the drilling and reaming of the mandrel bearings which should, properly, be bored; but one process is quick and the other not so, and this governed the choice of method. Final results were not as bad as expected, for the little lathe will part off mild-steel rod, ⅝ in. diameter without chatter, although the belt is just about beginning to slip under these conditions. This will give an indication as to what could be achieved on a small lathe which had properly bored and lapped spindle bearings.

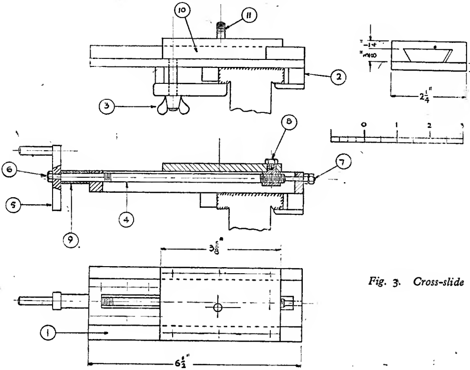


Fig. 3. Cross-slide

Cross-slide. Fig. 3

As already stated, this component, like the top slide, is entirely built up from mild-steel bar, strip and rod. In the sketches, the screws which hold the parts together have been omitted for clarity; but they are all 2 B.A., and $\frac{3}{16}$-in. silver-steel dowels are interspaced between the screws. The cross-slide consists of a saddle and vee-way (1), having two pieces of ½-in. square steel (2) attached to the lower surface, together with a simple clamp plate operated by a wing nut (3). This serves to clamp the unit to the bed and it is interesting to note that no trouble has been experienced in use, when the nut has been accidentally left loose. The feedscrew (4) is made from a length of ¼-in. diameter steel and is threaded ¼ in. Whitworth to engage with the nut (8). The screw was very troublesome to make since it had to be shouldered down at each end and threaded 2 B.A. for the locknuts (7) at one end and the nut (6) at the other. The reduced portion was made by first filing it square, then octagonal and so on, using a micrometer to make constant checks on the accuracy of the work. In addition, the Whitworth thread had to be true, and following a couple of failures, the rod was held in the chuck of the drilling machine, an improvised steady was rigged up to support the lower end, and a true start was made by holding the die firmly against the machine table. The handle (5) is made from ½-in. × ¼-in. material, is cross-pinned and held up to the shoulder by means of the nut (6). This arrangement gives a secure trouble-free fixing. A distance piece (9), greatly adds to the comfort and convenience of operating the feedscrew handle. The cross-slide proper (10) is built up from three pieces of steel and like the saddle is fitted with a gib. It carries a single ¼-in. B.S.F. stud (11) in order to clamp the top slide in position, and a guard, not shown in the sketch, was subsequently fitted to prevent chips fouling the dovetail slide. The nut (8) is a little block of steel tapped for the feedscrew and has a short cylindrical portion filed so as to fit a reamed hole in the cross-slide. The nut is secured to the slide by means of a 2-B.A. bolt as shown.

Top slide. Fig. 4.

Designed around a piece of 3-in. × ½-in. bright steel, which appeared to be the only material which could be pressed into service, the top slide

differs considerably from the cross-slide which supports it. The width of the material precluded putting the top-slide clamping nut anywhere but in the region of the dovetail, and, in turn, this meant that the feedscrew had to be arranged well away from the centre-line of the sliding member.

In the sketch, (12) is the base and vee-way and is built up from two pieces of material. The upper piece, forming the dovetail, has a circular hole (13) cut in it, which houses a thin ¼-in. B.S.F. nut, while the lower piece is drilled and reamed to receive the cross-slide stud (11) (Fig. 3). In addition to housing the nut, the hole (13) is large enough to receive the necessary box spanner which tightens the nut and hence the base (12) down on to the cross-slide. Two small bearing blocks (14) are secured to the base with 4-B.A. countersunk screws, and these carry the feedscrew (18). The latter is similar to the cross-slide feedscrew as also is the handle. The sliding member (15), which carries a ¼-in. B.S.F. stud for the tool box is built up from three pieces of steel, viz a top and two sides, the top piece having an extension to which is fastened a small piece of steel (17). Thus, in this region the thickness of the metal is doubled in order to give room for a tapped hole which engages with the feedscrew (18).

Access to the nut which clamps the top slide to the cross-slide is gained by rotating the feedscrew until the slide (15) is at its extreme right-hand position.

Felt wipers, not shown in the sketch, are fitted to both sides of the slide, and the tool box is also omitted. The latter is clearly shown in the photograph and is simply a block of steel drilled for the stud (16) and has a slot and two pinch screws for ¼-in. square tools. Readers may see in this tool box an embryo four-tool turret, but so far, it has been like the ears of corn which, lying in the tombs of Egyptian Kings, are reputed to grow when planted in the right kind of soil.

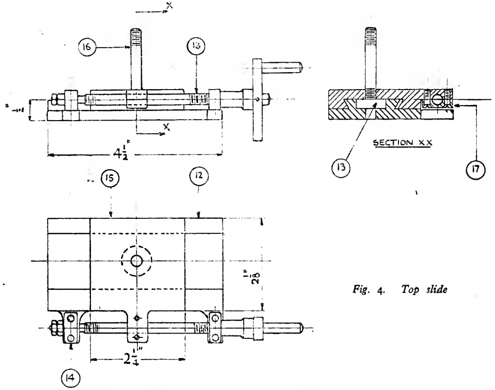


Fig. 4. Top slide

Alignment of Headstock with Bed

Before making the tailstock it was necessary to align the headstock so that the mandrel axis was parallel with the bed of the lathe within as close limits as could be obtained. To this end, the headstock and slide rest were assembled on the bed and a piece of ⅝-in. diameter silver-steel placed in the headstock bearings with about 4 in. protruding. A quick check with a "Unique" test indicator revealed two facts, first, the steel bar was slightly bent and, secondly, the bearings were not truly parallel with the machined base of the headstock. A second piece of silver-steel was tried in the bearings but this too, was not dead straight, but was accepted as being useful for the time being. To rectify the error in parallelism noted above, the base of the casting was filed and scraped until the error was much reduced. Adjustments such as these were made until the errors in parallelism, when checked in both the horizontal and vertical planes, were

considered to be reasonably small, any doubts about the matter being due to the fact that the test bar itself was not truly straight. It now remained to adopt some procedure which would enable an improvement to be made in the alignment and this was done as follows :

(1) First, a simple type of chuck was made

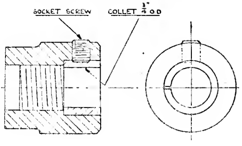


Fig. 5. Chuck

(Fig. 5) on the lathe itself, from a piece of steel which had a $\frac{5}{8}$-in. B.S.F. hole tapped through the centre. This had been ear-marked for the purpose and had been the factor in deciding on the size of the mandrel nose. The steel was screwed on the latter and turned and bored in position. A piece of $\frac{3}{4}$-in. round steel was then cut off, placed in the chuck and, after facing both sides, a hole was bored in it so as to be a close fit for a piece of $\frac{9}{16}$-in. steel rod. It was then removed, cut with a hacksaw as shown in the sketch, the result being a simple type of collet.

(2) A piece of $\frac{9}{16}$-in. steel rod was then held in the chuck with about $2\frac{1}{2}$ in. protruding. The top slide was then adjusted to turn this exactly parallel as measured with a micrometer.

(3) The test indicator was again set up in the tool box and a check made along the bar by *sliding the whole slide-rest carefully along the bed.* This check was made in both the horizontal and vertical planes, i.e., with the indicator button touching first the top and then the side of the test piece and it clearly revealed the remaining errors in alignment. After much trial and error in adjusting the headstock, a final stage was reached when, with the headstock bolts tightened down, the indicator showed that the test piece in the chuck was truly parallel with the bed of the lathe.

Tailstock. (Fig. 6)

It will be seen that this is of the " lever-feed " type. The hardened silver-steel barrel is $\frac{1}{2}$ in. diameter and can be removed by undoing a quick-release pin and its place taken by a barrel having a Jacobs' drill chuck fitted at one end. This design was adopted because it was not possible to machine a barrel of the orthodox kind.

After much work with saw and file, a mis-shapen lump of iron which happened to have a $\frac{1}{2}$-in. reamed hole through it assumed the shape shown in the figure and formed the body of the tailstock (24).

The base or soleplate (20) was built up from steel plate and bar in much the same way as was the saddle but no gib is fitted. A keep plate (22) is permanently fixed to the rear and a clamp plate (21) at the front is tightened by means of nut (23). A pin prevents the clamp turning when the spanner is applied. The body (24) is secured to the base by means of dowels and the two long studs and nuts (25). The barrel (26) is clamped in position by the thumb screw (27) which is made of brass to prevent damaging the barrel. It will be seen from the figure that the lever (30) is connected to the barrel by means of a short, forked link (29), the barrel itself being slotted in the region of the quick-release pin (28).

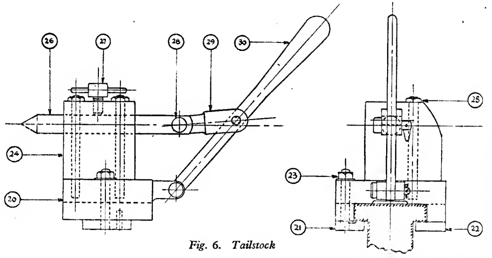


Fig. 6. Tailstock

It was, of course, necessary to align the tailstock barrel with the headstock and this was done by first chucking a length of $\frac{9}{16}$-in. steel and turning it parallel and to exactly the same diameter as the barrel. With the soleplate (20) completely finished and assembled on the bed, the base of the body was filed and scraped until, with the nuts (25) tightened down, the test indicator showed that the barrel was in line with the test piece in the chuck.

Final Operations

It has already been stated that some of the work on the lathe had to be done on the machine itself, and the final machining operations had to be carefully planned because the ability to do one depended to a certain extent on the successful completion of another.

Thus, with bed, slide-rest, headstock and tailstock assembled, the following work had still to be carried out before the lathe was complete.

(1) The mandrel had to be bored hollow and opened out to No. 1 Morse taper. A soft centre had to be made, together with a catch plate, and until this was done centre turning could not be carried out.

(2) A tailstock barrel to carry a drill chuck was required.

(3) A set of collets for the chuck had to be made.

These necessary jobs were done in the following order :—

(a) A 9/32-in. drill having a centre at the shank end and fitted with a carrier, was supported by the tailstock and the mandrel drilled as far as the drill would reach. The mandrel was then reversed in its bearings and the drilling repeated.

(b) The mandrel nose was then bored and reamed No. 1 Morse taper and a centre made from $\frac{9}{16}$-in. diameter steel.

(c) To make the catch plate, a $\frac{5}{8}$-in. B.S.F. tap was obtained and a steel blank threaded to screw on the mandrel nose. The blank was then turned to shape. Only light cuts could be taken on the largest diameter, which was 2 in., but this job proved that the little lathe was capable of quite useful work.

(d) It was now possible to turn between centres, so a tailstock barrel having a taper for a drill chuck was made.

(e) Finally, a set of collets for the chuck was made, the smaller sizes (up to $\frac{1}{4}$ in.) being drilled from the tailstock and the remainder bored with a little boring tool.

Conclusion

The lathe was completed early in 1946 and took about eight months of spare time to build. Since then it has been in constant use and often runs for many hours at a stretch. The headstock bearings appear to be wearing very well and the slide-rest feedscrews, which are only $\frac{1}{4}$-in. Whitworth, are even now in quite good condition.

The fact that a makeshift design, like the one described, can turn out useful and accurate work suggests that those who possess a larger, back-geared machine—say of 3-in. centres, could quite easily make a very accurate small lathe capable of real precision work.

It can certainly be said that, for very small jobs, the little, single geared lathe, running at high speed and having light, sensitive, slide-rest controls, is a joy to use and its performance will be a revelation to those who have hitherto only had the use of a larger machine.

A Universal Swivelling Vice

(Continued from page 629)

may, however, question the necessity for such measures, which in the terms of the popular misquotation, are like " gilding the lily."

Several readers have written expressing their appreciation of the design of this little vice, which is regarded as one of the most useful additions to the equipment of any model engineer, no matter what class of work he may be handling. Those who have seen and handled the actual vice illustrated have been even more enthusiastic, and several of them wanted to buy it on the spot! It is, however, only fair to add that there has been at least one decided dissentient to this opinion, and one reader, in a critical letter, complains of the " waste of space " allotted to its description, suggesting that " it could have been dealt with in a single paragraph."

It is not known how many readers will agree with this view, but the general consensus of opinion, as expressed by readers' requests, shows a large majority who clamour for more and more detail in descriptions of " how to make things " ; for information, drawings and action photographs showing workshop procedure and machining set-ups. There are undoubtedly an increasingly large number of potentially capable but inexperienced readers, who can turn out really good work, provided they are shown how to proceed, and are guided past the snags and pitfalls which abound in any advanced mechanical work. It is to them that the writer's efforts are devoted, and there is plenty of evidence, in the examples of workshop equipment seen in model engineering exhibitions, not to mention the much greater number hidden (though by no means relegated) in home workshops, that this policy bears forth good fruit.

A well-known connoisseur of fine tools has asked " where are the centre-pops on the ends of the jaws ? " This refers to the indentations which are often provided on the jaws of high-class watchmakers' vices, to enable them to serve as a substitute for a depthing tool in gauging the meshing distance of wheel pivots. As the vice is not specifically intended for horological work, this feature is not provided for in the design, but there is no objection, nor any difficulty, in adding it, if the user is likely to find it desirable.

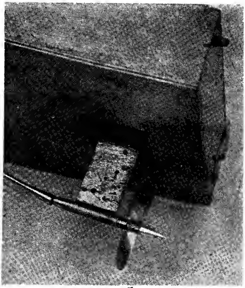
*In Search of Speed

Further Developments of "Faro"

by Kenneth G. Williams

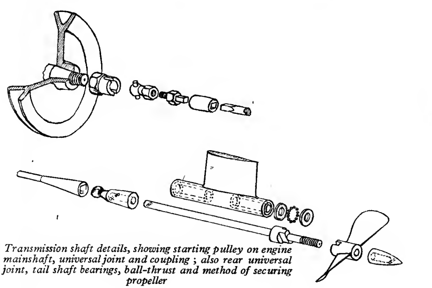
THE float feed carburettor is of a very elementary type having a needle regulated adjustable submerged jet delivering fuel into a small vertical primary choke which discharges a very rich fuel/air emulsion into the horizontal main choke, thus giving what is known as double diffusion. No throttle valve is used, only a choke air shutter for starting purposes. The carburettor has sufficient static compensation to allow the boat to get away on a wide open choke tube. It is built up from aluminium alloy castings for the choke tube and float chamber, while the jet block and other small parts are made from brass rod. A commercial float and needle are used. (Amal 22/016 and 22/013 respectively.)

*Continued from page 607, "M.E.," May 19, 1949.

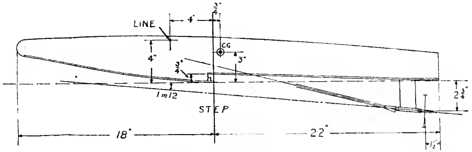


Rear bearing, skeg and propeller

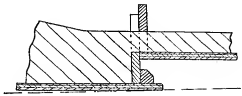
The transmission shaft and associated parts are shown in the exploded view and do not call for any separate description except to say that the shafts are of standard $\frac{3}{16}$-in. diameter ground silver-steel rod, the engine driving nut R. T. chrome steel hardened and tempered, and the rear universal joint parts in mild-steel, case-hardened, soft-soldered and pinned to the shaft. The ball-



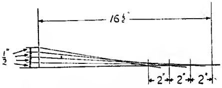
Transmission shaft details, showing starting pulley on engine mainshaft, universal joint and coupling; also rear universal joint, tail shaft bearings, ball-thrust and method of securing propeller



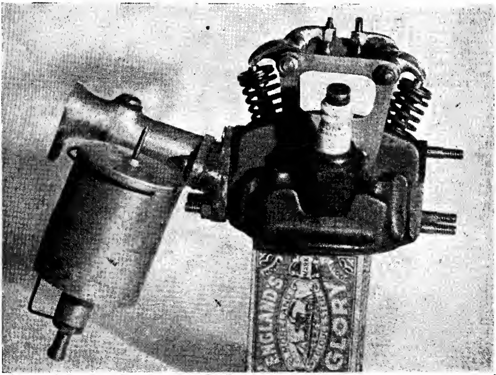
General layout of "Faro's" hull



Cross-section at the step



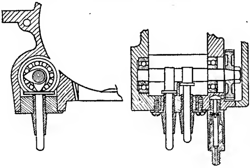
Setting out the fore plane



The new cylinder-head

bearing thrust-race is composed of two grooved washers of unhardened silver-steel loaded with $\frac{1}{16}$-in. diameter balls.

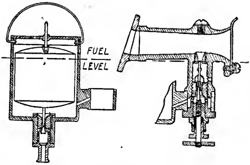
The supply of " hard " sparking-plugs capable of resisting great heat has dried up, but satisfactory substitutes may be made quite easily by modifying various ordinary types, and good results have been obtained. The essential features of a racing plug are, a small area of insulator exposed to the heating effects of flame



Redisigned tappet-gear and pressure release-valve

in the cylinder and a short heat path through the insulator and body of the plug to the metal in the cylinder head, and this emphasises the need for well-fitting screw threads to conduct the maximum amount of heat. The electrodes should be short and of substantial section.

Drawing No. 53 shows a typical " soft " plug and No. 54 shows how it appears after modification to render it suitable for high compression at high r.p.m. The method of altering non-detachable plugs is to cut away the external earth electrode and insert a thin

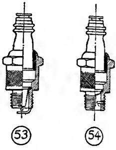


Carburettor details, showing float chamber and arrangement of adjustable jet, primary and main chokes with starting air-shutter

screwdriver blade between the insulator skirt and the body of the plug ; a sharp tap on the end of the screwdriver will usually snap off the insulator cleanly near its base. The centre electrode is shortened, and this may be done safely by first making a metal bush a drop-in fit into the plug body to support the electrode while turning it, otherwise it will bend, catch up in the turning tool and be torn out. A new earth electrode made from nickel wire is screwed and inserted through the side of the screwed part of the plug, then dressed off flush with the outside threads. Detachable pattern plugs are, of course, much easier to alter.

It may be mentioned that there are many small two-stroke engines working satisfactorily with soft plugs having very thin points and a long insulator skirt, but these are almost invariably used with methanol fuel which generates much less heat than petrol so that the plugs run much cooler. *Faro* is running at present on a fuel composed of 75 per cent. pool petrol and 25 per cent. benzol.

The single point of attachment of the hull to the tethering line has been used on *Faro* up to July, 1948, and at any speed over about 41 m.p.h. she was very unstable, resulting in frequent capsizes, so as an experiment the two-point " bridle " attachment was tried out and immediately proved its worth by keeping the hull under better control and allowing the engine power to exert itself to better effect. Speeds now began to creep up again to 45, 48 and then over 50 m.p.h. In November, 1948,



53.—*Standard spark-plug*
54.—*Modified plug to resist heat*

new records were set up for class " A " hydroplanes by covering 500 yards in 20.1 secs., equal to 51.1 m.p.h. and 1,800 yards in 75.6 secs., equal to 48.7 m.p.h. This is the first occasion when an all British home-built engine and hull has officially exceeded 50 m.p.h. The same performances gained an award in Class " A " in the 1948 MODEL ENGINEER annual speed competition. During the same year *Faro* had appeared at six regattas and run in seven races, gaining six firsts and one second place.

These speeds were achieved using a propeller of 3 in. diameter and 6 in. pitch, so that allowing a conservative figure of around 20 per cent. for propeller slip, the crankshaft speed is about 11,500 r.p.m.

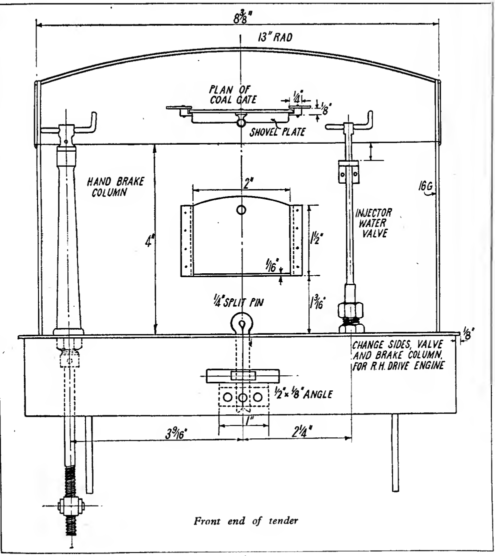
A new cylinder head has now been made to replace the original in use since 1936, using a similar casting but having the inlet port increased in size from $\frac{9}{16}$ in. to $\frac{5}{8}$ in. diameter, while the exhaust port remains unchanged at $\frac{9}{16}$ in. It is proposed to keep the compression ratio at

(Continued on page 644)

Tender Details for "Maid of Kent" and "Minx"

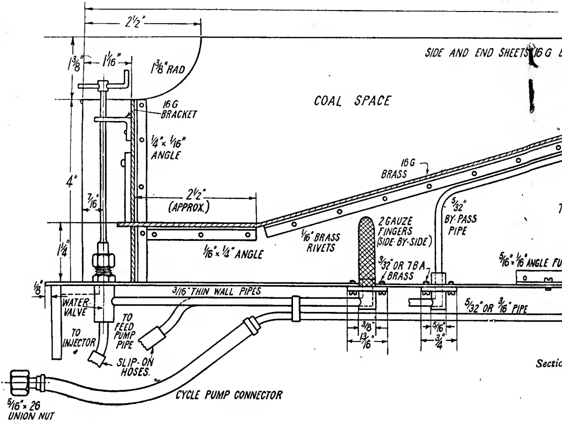
by "L.B.S.C."

THERE is not a wonderful lot of difference in the construction of the tender bodies, and none at all in their internal fitments, so one lot of instructions can be used for both. The chief difference in their personal appearance is, that the "Maid's" tender is straight-sided, an extension of the side sheets forming the coal rail, whilst the "Minx" sports the "old look" with a flared coping and separate coal rails. The former is easier to make; and any builder of the "Minx" who doesn't care twopennyworth of cold tea what Inspector Meticulous says, does, or thinks, can hang a tender of that type behind his engine, and she won't be any the worse for it.



Front end of tender

As a matter of fact, that is precisely what would happen in full-size practice, if tenders didn't outlast the engines ; and for reasons of capacity, some engines often have an old tender replaced by a modern one carrying more coal and water. When the full-size "Grosvenor" first came out, she had a small, low-sided, outside-framed tender which was later replaced by a more modern one, with inside frames. Talking about the life of a tender, the other day a whole string of them went by here, hauled by a goods engine. It was a proper museum procession—Craven, Stirling, Wainwright, Stroudley, Billinton—all were represented. The tanks and running gear of the old tenders being still serviceable (they *built* engines in those days !) they are used for conveying and storing weed-killer, anti-freeze, and other liquids used by the railways. Rumour has it that the ultimate fate of the tenders of the "queer ones" and the "spam cans" will be garden sieves and colanders !

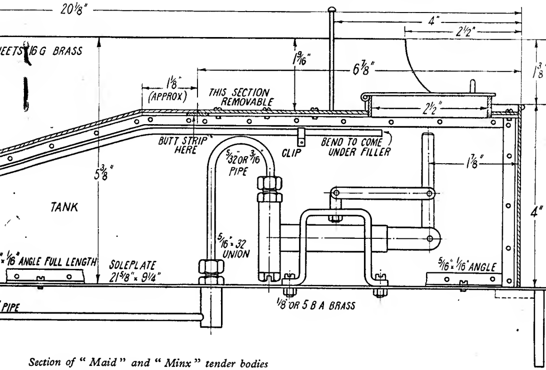


Straight-sided Tender

However, getting back to our job, about the easiest way to build up the body of the straight-sided tender, is to use separate sheets for the sides and back, in consequence of the size ; though personally, if I had a piece of 16- or 18-gauge hard-rolled sheet brass big enough, I should make a one-piece job of it, as my new "Diacro" bending brake would make short work of the corners, in less time than I can write these words. One advantage of three-piece (sides and back) construction for an inexperienced sheet-metal worker, is that he can make sure both sides are cut exactly to the same contour and dimensions. All the sizes are given in the accompanying illustration. Another tip for beginners : before joining your side sheets to the back sheet, mark off the position of the angles for supporting the bottom of the coal bunker, and the removable part of the tank top. Cut your pieces of brass angle ; tack them to the side sheets with a touch of soft solder at each end, and a couple of intermediate blobs on the long inclined bit, then go ahead and rivet. You'll find it ever so much easier, on a tender of this size, to do all the work you can on the various components, before putting them together. The assembled tender is a hefty lump to twist and turn about, even on your bench, and the very dickens to hold up whilst putting rivets in. Brass angle of ¼ in. by 1/16 in. section will do fine for the supporting angles, also the corner angles ; it would be as well to use 5/16 in. by 1/16 in. for the full-length angles along the bottom, the merchants whose

job it is to hold the body down to the soleplate. Another big advantage of riveting on all the angles before assembling sides, back, and front plates, is that they are rendered stiffer, and not liable to distort when sweating up the bottom joint to render it water tight. Sheet brass buckles under local heat, and some of my correspondents have told woeful tales of what their tenders looked like after the sweating-up operation.

a few minutes. Anybody who uses the old method of drilling holes all around, breaking the piece out, and filing to size, be careful not to distort the plate. A runner is riveted at each side of this hole; this is made from $\frac{1}{8}$-in. by $\frac{1}{4}$-in. flat rod, with a $\frac{1}{16}$-in. rebate milled or planed in one side (see small detail sketch). The rebate can be milled in the lathe, by the method I described for axleboxes. The gate itself is merely a piece of



Section of "Maid" and "Minx" tender bodies

Front and Back Sheets

The back sheet is merely a piece of 16- or 18-gauge sheet brass, $8\frac{1}{4}$ in. long and 4 in. wide, with a piece of $\frac{1}{4}$-in. by $\frac{1}{16}$-in. angle brass riveted along the upper edge, approximately $\frac{1}{4}$ in. below same. Check the height of this, from the pieces already riveted to the side sheets, as they must be level with each other. A piece of $\frac{5}{16}$-in. by $\frac{1}{16}$-in. angle is also riveted along the bottom, same as on the sides. Don't forget to cut these pieces of angle $\frac{1}{4}$ in. short at the top, both sides, and $\frac{5}{16}$ in. at the bottom, otherwise you won't be able to assemble the body, on account of the side angles fouling the end ones. Unnecessary warning? Don't you believe it!—my correspondence tells a tale, and it is easy to make a slip; I'd love to know how many good folk have silver-soldered union cones to a pipe without putting the nut on first!

The front sheet is the same size as the back, but it has a refinement in the shape of a coal-gate, and the angles are arranged differently. At $1\frac{3}{16}$ in. from the bottom, and in the centre, cut a rectangular hole 2 in. wide and $1\frac{1}{2}$ in. high; the sort of job an Abrafile can do in a matter of

16- or 18-gauge sheet metal, cut to slide in the runners, as shown; no need to fit it now, it will only fall out, wait until the tender is erected. A small knob is turned and riveted in, for lifting purposes. This coal-gate is not the same as on a full-size "L1" tender, but it is correct for the "Minx's" tender, easier to make, and more convenient to use, which is why I specify it. As a matter of fact, a coal-gate is not needed at all, but the front sheet looks bare without one, and I always fit them on my own engines.

Rivet a piece of angle along the bottom, same as on the back sheet; then rivet two short pieces of angle, one at each side of the coal-gate opening, and level with the bottom of it. Yet another piece is riveted flush with the edge of each side, for the full length, for attachment to sides of tender. It certainly looks as though we are attacking this job from every conceivable angle, but as we are building proper locomotives intended for real work, and not so-called "models," we might as well follow the procedure of a full-size C.M.E. and make it able to stand up to whatever stresses, strains, or rough usage that may come its way. Of course, anybody who happens to

be hot stuff at what my one and only niece used to call "bendification" in her schoolgirl days, could dispense with the side angles on the front plate, and bend over the self-material for about $\frac{5}{16}$ in. or $\frac{3}{8}$ in. each side, so that the overall width remained at $8\frac{1}{4}$ in. This is another job that my new acquisition from the O'Neil-Irwin Manufacturing Company would do to precision limits in a matter of seconds, after the shearing machine from the same source had cut the plate accurately to size, in equal time and with equal facility.

Assembly and Erection

First job is to rivet the back plate or sheet, to the ends of the side sheets, by means of the angles on the latter; and if a toolmaker's cramp is used to hold the parts together, at top and bottom, and the plates adjusted so that the end of the body is square, it makes easy work. Drill the holes either No. 51 and use $\frac{1}{16}$-in. brass rivets, or No. 41 and use 3/32-in. rivets, as you please. There are no rows of protruding rivet-heads adorning the tenders of either the "Maid" or "Minx's" full-size sisters; so countersink the holes on the outside, and hammer the rivet shanks flush. Finish off with a fine file and emery-cloth, and leave the surface perfectly smooth.

The front plate is set between the sides, at a distance of $1\frac{1}{16}$ in. from the front ends of the side sheets, as shown in the sectional illustration, and held in position by toolmakers' cramps at each side, whilst the riveting is carried out. Observe the same strict caution as before, to get the plate in truly and square. You should now have a structure with nice square corners, that doesn't rock cornerwise when you stand it on the lathe bed. If O.K. it may now be erected.

First of all, drill a series of No. 40 holes all around the angles at the bottom, at about 2 in. centres, which is easily done with the tender body upside down. If you have a fast-running drilling machine which will admit the tender body between chuck and table, this job is another cake-walk. When I had only a hand drilling machine, I mounted it on the edge of my bench, so that I could get any depth between chuck and floor, by swinging the table aside and propping up the job with wood blocks; that was how I managed to drill holes in the ends of boilers. Some beginners who are short of equipment (all too expensive in these days!) may find the wheeze useful. As a last resort, use the hand drill brace.

Stand the tender body on the soleplate, and adjust so that longitudinally it is central, with approximately $\frac{7}{16}$ in. of "gangway" each side; the front ends of the side sheets should be $\frac{7}{8}$ in. from the front edge of the soleplate, but "mike" measurements are not needed. Then clamp the body temporarily to the soleplate. An easy way of doing this, is to put two bits of wood, say about 1 in. square—anything you have handy will do—across the top; two similar pieces under the frames between the wheels; then connect the ends of each pair, top and bottom, either by thin coach-bolts, or bits of $\frac{3}{16}$-in. or $\frac{1}{4}$-in. rod, screwed at both ends and furnished with nuts and washers. Run the No. 40 drill in all the holes in the angle, making countersinks on the soleplate; follow with No. 48, tap 3/32 in. or 7-B.A., and put brass screws in, any heads you happen to have in stock, being quite suitable.

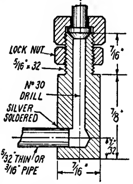
Did I hear some beginner say, how on earth do we get the drill in, when the chuck will foul the tender side? Simple, my dear Watson, as Sherlock Holmes would have said. Put a bit of $\frac{3}{16}$-in. round rod about 6 in. long, in your three-jaw; face, centre, and drill about $\frac{1}{2}$ in. down with No. 43 drill. The business end of that last No. 40 drill you broke, is driven into the hole (you'll be superhuman if you haven't a broken drill!) the other end of the rod is held in the drill chuck, and that same chuck will be well above the tender side whilst the drill is in use. Make a similar extension for a bit of 48 drill. As for the tap, use a bit of copper tube about 7 in. long, of a diameter that will just go over the squared end of the tap shank. Knock the tube into close contact with the square; put a tap-wrench on the other end, and you're right there, like the parachutist who landed in the middle of the duck pond.

When all the screws are in, and tightened up, sweat all around the angle and over the screw-heads, as the tender body must be watertight. A good big soldering-iron is as good as anything for this job; if you apply a blowlamp flame, there is a likelihood that the sides of the tender will buckle. When young Curly started work at the locomotive sheds (at two shillings reward for a $9\frac{3}{4}$-hour day—6 a.m. to 5.30 p.m. less $1\frac{3}{4}$ hours for meals) he wheedled a couple of scrap copper staybolts off the boilermakers' foreman, and they made champion soldering-irons. Use the same kind of liquid flux as you used for sweating the boiler stays, and wash off well with hot water when through. Never use either paste flux or cored solder for locomotive work.

Bunker Bottom and Tank Top

The plate forming the bottom of the coal space, or fixed part of the tank top, calls for a piece of 16-gauge sheet brass measuring $8\frac{1}{4}$ in. by $12\frac{3}{4}$ in., the front end of which is cut away to leave a tongue projecting $\frac{1}{4}$ in. through the coal-gate, to form a shovelling-plate. At approximately $2\frac{1}{2}$ in. behind the front plate, the bottom plate is bent to the slope of the side angles in the tender body, and at approximately $1\frac{1}{4}$ in. from the end, it is again bent to the horizontal. The exact amount of bending, can best be obtained from the actual job; the plate should be in contact with the angles for full length each side. All around the edge, except the tongue which goes through the coal-gate, drill and countersink No. 43 holes 5/32 in. from the edge, at about $1\frac{1}{2}$ in. centres. Along the back end, on the underside, rivet a butt strip $\frac{1}{2}$ in. wide, of 16-gauge brass, leaving half its width projecting. Now fit the plate to the tender, and screw it down to the side angles by the same method of procedure used for screwing down the body to the soleplate. Use 8-B.A. countersunk brass screws; protruding heads are a nuisance as they catch the shovel when you are firing the engine on the run. When the plate is screwed down tightly, sweat around the whole issue, same as the joint between body and soleplate, and don't forget the bit under the coal-gate, which has to be done from the outside. **Be careful to wash off all the flux.**

The removable part of the tank top is made from a piece of 16-gauge sheet brass, $8\frac{1}{4}$ in. wide, and long enough to fill in the space between the fixed part, and the back of the tender; measure from the actual job. Scribe a line down the centre; and starting at $\frac{9}{16}$ in. from the back, set out a rectangular hole with rounded corners, $2\frac{5}{8}$ in. long, and 1 in. wide. Cut it out by same process as for the coal-gate hole; then, from a strip of 16- or 18-gauge sheet brass $\frac{1}{2}$ in. wide, bend a rectangle to fit the hole, with a butt joint in the middle of one of the short sides. Fit this in so that $\frac{1}{8}$ in. projects through the underside of the plate, the joint being at the front end; then solder all around it on the underside.



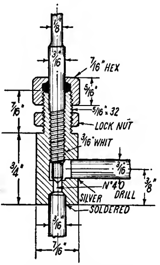
Hand-pump fitting

The flap lid is made from a piece of 16- or 18-gauge sheet brass, cut to the same shape as the hole, but 1/32 in. larger all around. Leave two tags $\frac{1}{8}$ in. wide and $\frac{1}{4}$ in apart, at the front end; bend these into loops which are a tight fit for a piece of 15-gauge spoke wire, rustless steel, or bronze. Cut a strip of metal to fit between the loops; bend the end into a similar loop, put it between the eyes, and put a pin through the lot. The end of the strip is cut off to project down and touch the tank top when the lid is in position; and it can be soldered to the filler, over the joint. This is quite strong enough, as there is no strain put on the hinge by merely opening and closing the lid. A wire arch-shaped handle is riveted into the other end.

Drill No. 43 holes all around the edge of the plate, at 5/32 in. from the edge, and about $1\frac{1}{2}$ in. centres. Repeat the countersinking, drilling and tapping operations for the screws, same as for the bunker bottom, but no soldering is required. Don't put any screws in yet, as we have to install the hand pump. I have already described how to make this, for testing the boiler, and it is only a few minutes' job to put it in the tank. Set the handle up straight, and put the pump in the tender, in such a position that the vertically placed handle comes exactly under the centre of the filler hole (see sectional illustration). Run the No. 30 drill through the holes in the feet or lugs of the pump stand, and carry on through the soleplate, scrape off any burrs underneath the soleplate, then secure pump with four $\frac{1}{8}$-in. or 5-B.A. brass screws and nuts, heads inside tank, and nuts underneath the soleplate. A smear of plumbers' jointing on the threads will prevent any leakage.

Fittings and Pipe Work

At approximately $1\frac{1}{4}$ in. ahead of the pump valve-box centre, and a little to the left-hand side (exact position doesn't matter) drill a $\frac{5}{16}$-in. clearing hole, letter "O" drill; and in it, fit the doings shown in the small detail illustration. Chuck a bit of $\frac{7}{16}$ in. round or hexagon brass rod in the three-jaw; face the end, centre deeply with a centre-drill, and drill down No. 30 for a bare $1\frac{1}{4}$ in. depth. Turn down $\frac{7}{16}$ in. of the end to $\frac{5}{16}$ in. diameter, and screw it $\frac{5}{16}$ in. by 32. Part off at $\frac{7}{8}$ in. from the shoulder; then at 7/32 in. from the bottom, drill a 5/32-in. or $\frac{3}{16}$-in. hole, according to which size pipe you are using. If you can get 5/32-in. pipe with a thin wall, say about 24-gauge, use that, as it makes a neater job; otherwise use $\frac{3}{16}$-in. Cut a length of 10 in., and silver-solder it into the hole; soften the other end of the pipe at the same heating. Pickle, wash off, clean up (never mount dirty fittings, on any account) and poke the screwed end through the hole in the soleplate, securing it with a lock-nut on top, as shown. Make the lock-nut from



Injector water-valve

$\frac{7}{16}$-in. hexagon brass rod, a kiddy's practice job needing no detailing. The pipe should run to the front end of the tender, and is bent slightly down at the end.

The top end of the angle fitting is connected to the delivery union of the hand pump by a swan-neck of 5/32-in. or $\frac{3}{16}$-in. pipe, which is furnished with nuts and cones at each end, as shown in the sectional view of the fitting. A flexible "feedbag," as the enginemen call it, is attached to the front end of the pipe, in place of coiling the pipe itself; this is far more satisfactory on engines of "Maid" and "Minx" dimensions. A piece of pressure-resisting hose, such as a cycle or motor tyre pump connector, is pushed over the end of the copper pipe, and secured with a clip. A short piece of pipe, with a union nut and cone on it, is fitted to the

other end, for connecting to the union under the engine drag-beam.

Strainers should be fitted to the pump and injector feeds, and these are simply gauze fingers attached to flanged fittings which can be fixed underneath the soleplate, and readily detached if they should need cleaning. The fittings can either be turned up from castings, or from $\frac{13}{16}$-in. round brass rod. Castings will only need the spigot turned, flange faced, and waterways drilled, the casting being held by its longer end in the three-jaw. If solid rod is used, chuck in three-jaw, face the end, and turn down $\frac{3}{8}$ in. length to $\frac{3}{8}$ in. diameter ; part off at $\frac{5}{8}$ in. from the end. Reverse in chuck, holding by the turned part, and turn down $\frac{1}{8}$ in. of the end to $\frac{3}{8}$ in. diameter, leaving a full-diameter flange $\frac{1}{8}$ in. thick. Centre, and drill down $\frac{1}{2}$ in. deep with $\frac{3}{16}$-in. drill. At $\frac{1}{8}$ in. from the blind end, drill a No. 13 hole right into the centre one ; also drill three No. 41 holes equidistant around the flange, for the fixing screws. Silver-solder a $5\frac{1}{2}$-in. length of $\frac{3}{16}$-in. pipe into the side holes. Roll up two gauze fingers about $1\frac{1}{2}$ in. long, using brass or copper gauze of fine mesh, and squeezing up the tops ; put these over the spigots, and solder them. Before fitting to the soleplate, the injector water-valve must be made and attached to one of them.

Injector Water-valve

A section of the injector water-valve is shown in the accompanying illustration, and as the gadget is made by the same process used for the by-pass valve, there is no need to recite the ritual again. The upper part is $\frac{7}{16}$ in. long, and furnished with a lock-nut, same as the hand-pump fitting, and a piece of $\frac{3}{16}$-in. pipe about $1\frac{1}{4}$ in. long, is pressed into the bottom. The valve pin can be made either in one piece, or two ; use $\frac{3}{16}$-in. rustless steel or phosphor-bronze, a piece $4\frac{3}{4}$ in. long being required for a one-piece stem. It may, of course, be left full diameter for full length, but looks better if the upper part is reduced ; and beginners can turn this down without a steady, by having about $\frac{3}{4}$ in. projecting from the chuck jaws for a start, turning that to size (a full $\frac{1}{8}$ in.) pulling another $\frac{3}{4}$ in. out and turning that, then "ditto-repeatoing" until $3\frac{1}{2}$ in. has been reduced. Then reverse in chuck, screw the end $\frac{3}{16}$ in. Whitworth for quick action, reduce the end, and turn the cone, as shown in the section. For a two-piece valve-pin, make the screwed part $1\frac{1}{4}$ in. overall length ; centre the upper end, and drill about $\frac{1}{8}$ in. depth with No. 32 drill. Squeeze a length of $\frac{1}{8}$-in. steel rod, rustless for preference, into this hole, silver-solder it, and cut to same overall length as the one-piece pin. Drill a No. 13 hole $\frac{3}{8}$ in. from the bottom of the valve, and fit it on the end of the pipe attached to one of the strainers (see section of tender body). Silver-solder this joint, and the bottom pipe, at the one heating ; then pickle, wash off and clean up. We'll leave the erecting till next instalment.

In Search of Speed

(*Continued from page* 638)

10 to 1 as at present and to continue running on the petrol/benzol mixture. The larger inlet-valve port will probably give increased r.p.m. which in turn will allow a slightly larger carburettor choke to be used without reducing air velocity. The greater weight of fuel and air admitted will most likely maintain brake mean effective pressure at the higher r.p.m., which means increased power. This in turn may also allow a propeller of slightly greater pitch to be used—all these factors mean higher speed, and so it goes on.

No attempt has yet been made to use alcohol fuels, and this is a further field to explore. Such fuels produce a lower temperature in the cylinder than when petrol is used, and allow much higher compression ratios to be employed. Overhead-valve four-stroke engines do not lend themselves quite so well as two-strokes to very high compression, as valve-head clearances impose a mechanical limit to the ratios which may be utilised.

Both the planing surfaces of the hull have been renewed since originally constructed, the inclination of the fore plane remains at 33 to 1, but the rear plane has been fined down to 1 in 80 on the centre-line and still washes out to no lift at the chines. When *Faro* is going really fast she runs with both planes clear of the water and the propeller "surfacing" for distances up to about 30 ft. before touching down again, and this reduction of surface drag on the planes naturally helps the speed. The hull is very sturdily constructed and rather on the heavy side, weighing about $15\frac{3}{4}$ lb. in running trim. This feature emphasises the importance of a high power/weight ratio, because power absorbed in weight lifting is lost to forward propulsion. This is a further line to explore, and to this end consideration has been given to building a very light hull employing three-point suspension, surfacing propeller, and adopting one of the miniature magnetos now available which will cut out the weight of the present battery, ignition coil, and quite a lot of wiring. All that is lacking is the time to do so.

One of the happiest features of the racing power boat fraternity has always been the obvious willingness to help each other, and anyone in difficulty has only to ask another enthusiast for advice or suggestions, when all his knowledge and experience is at once forthcoming. I should like to place on record my own appreciation of much valuable help I have received in this way.

In this connection, let us not forget the debt we all owe to THE MODEL ENGINEER which has striven for so many years in support of power boat enthusiasts and in particular to Mr. E. T. Westbury whose well-informed articles have started many readers on the road to success in this sport.

A Stayless 2-in. Scale Locomotive Boiler

by R. A. Briggs

THE unusual features of this boiler are not new or untried, as the first of a series of six was built over 50 years ago; the next was constructed for my 2-in., 10¼-in. gauge locomotive in 1906 and remained in use for 30 years giving excellent service, it is just a combination of firetubes and watertubes.

Some 12 years ago I decided to bring the engine up to date by adding an extended smokebox and increasing the superheat, this was a suitable opportunity to provide a new boiler similar to the original except that the new one is all welded in place of flanging and riveting.

Having obtained the steel shell with ¼-in. thick barrel and $\frac{5}{16}$-in. ends and new solid drawn ⅞-in. copper tubes, I proceeded to build, and upon dismantling the old boiler, was struck by the wonderful condition of the firebox coil which had been in use 30 years. After a thorough examination, I had no hesitation in embodying it in the new, and now after 42 years, it shows no sign of wear and carries the original 100 lb. pressure.

A similar boiler on a nearly half full-size traction engine built about the same time as the locomotive, carried a pressure of 150 lb. and was illustrated on the front cover of THE MODEL ENGINEER, August 15th, 1946. This engine I disposed of and the last I heard of her was from Beaulieu, Hants.

Rainwater only is used in all my boilers of which I have some 15, and all are absolutely clean and free from scale. Rainwater is cheap and plentiful.

The following are the main points of the boiler:

(1) There are no stays in the entire boiler.

(2) There are no bushes, all fittings being screwed directly into the plates.

(3) The boiler barrel is extended over the fire, giving the effect of a brick arch and adding considerably to the firetube and general heating surface.

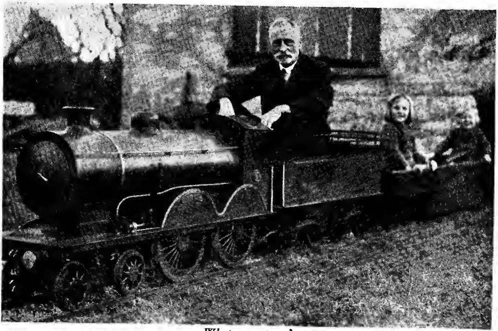
(4) There are twenty-seven ⅞-in. firetubes and two 1½-in. superheater flues. I suggest this number could not be obtained at the same spacing in an orthodox firebox.

(5) The corrugated sides of the firebox coil give increased heating surface.

(6) The small amount of heating surface lost above the coil is more than made up by increased heating-surface referred to above.

Apart from the ease of manufacture the matter of cost is interesting; the new welded shell and

(*Continued on page* 649)

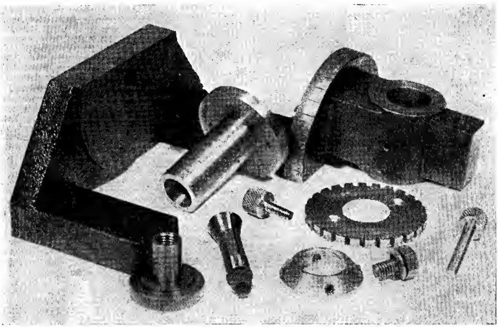


What—no stays?

*Constructing a Gear-Cutting Machine

by J. S. Eley

THE spindle is turned from $1\frac{3}{4}$-in. diam. mild-steel. The blank is chucked, leaving sufficient projecting to machine the portion of the spindle which is reduced to $\frac{7}{8}$ in. diameter and this portion is now roughed down to within 1/32 in. of finished size. The next job is to drill, bore and finally ream the bore of the spindle. The size will depend on the type of collet it is proposed to use, but in any case all taper boring or counter-boring necessary to fit the shape of the collets to be used, must be done at this setting. Having carefully finished off the collet seating, the outer diameter of the spindle is now carefully finish-turned down to $\frac{7}{8}$ in. It is most important that the collet seating should be concentric with the outer diameter as on this, amongst other things, depends the accuracy of all gears which will be cut. This done, the spindle is removed from the chuck and mounted on a mandrel for turning the flange on which the division plates will be mounted. Finally, two $\frac{1}{4}$-in. Whitworth tap holes are required which can be spotted through from a division plate. The spindle is secured at its upper end by a collar bevelled off to 45 deg. to avoid interference when cutting very small gears. The method suggested here is to saw off a blank slightly more than $\frac{3}{8}$ in. thick, chuck this, bore it and face one side. Remove from the chuck and drill and tap the holes for the four set-screws. Using small $\frac{3}{16}$-in. Whitworth Allen set-screws, mount the blank on the spindle just machined with the rough side overhanging a little. The whole is now mounted on a mandrel and the collar taper turned and finished off between centres.

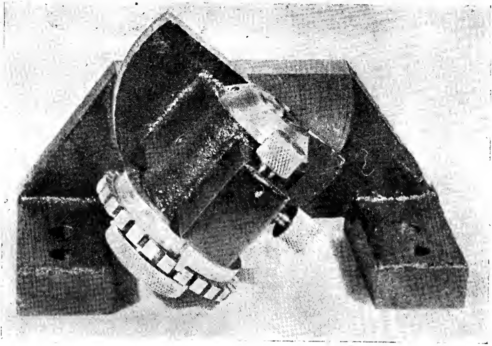


Components of bevel-gear attachment

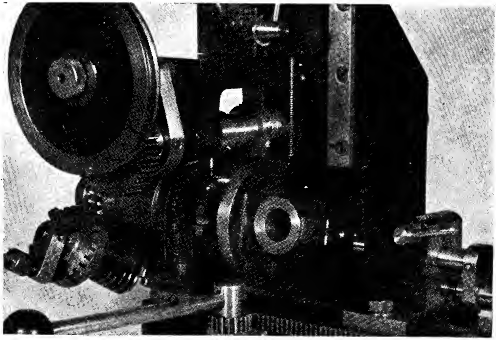
The locating plunger should be turned down to be a good fit in the hole drilled for it in the dividing head as there must be no shake in this part when fitted. The plunger tip is filed to a gentle taper so that when pressed into the slots in the division plates there is no tendency to loosen or spring out again. Case-hardening of the tip is desirable. Theoretically there should be no need for a locking screw but in practice it is advisable, as it will prevent any possibility of the blank shifting under the vibration of a heavy cut. Before fitting the locking screw, place a small brass pad in the tap hole to avoid marking the spindle. The heads of both plunger and locking screw are knurled.

To locate the attachment on the machine table.

*Continued from page 571, " M.E.," May 12, 1949.



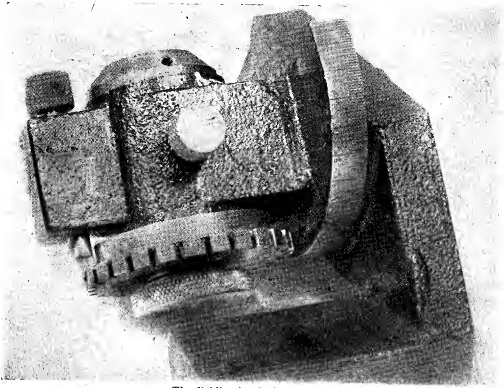
The bevel-gear attachment complete



Engraving the dividing-head in degrees

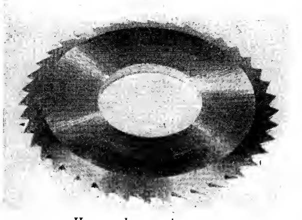
turn two studs from $\frac{1}{2}$-in. mild steel. The $\frac{3}{8}$-in. spigots are made a light push fit into the two holes drilled on the dividing-head centre line, the larger diameter fitting in the $\frac{1}{2}$-in. groove milled in the machine table. The two tap holes for bolting down the attachment can be spotted through from the clearance holes.

The only item left now is the engraving in degrees of the machined edge of the semi-circular pad on the dividing-head. If the machine has already been completed, one cannot do better than use it for this purpose, one of the photographs shows this being done. We have already one centre in the $\frac{1}{2}$-in. spigot, but to mount between centres, another one will be necessary on the locating plunger pad. To drill this, chuck the casting (or grip it in a collet if available) by the $\frac{1}{2}$-in. spigot and set to run truly by "clocking" the edge to be engraved. When running truly, carefully centre-drill the other end. A very small centre only is necessary, just sufficient to support it as there is no stress on it in this operation. It is possible to buy angle cutters which can be used for engraving but they are rather expensive and so I made my own from a small slitting saw. This was mounted on a mandrel and when running truly, was ground down to 20 deg. using a home made toolpost grinder mounted on the top slide which was set over to that angle. This cutter which is only $1\frac{1}{2}$ in. diameter $\times$ $\frac{1}{16}$ in. thick is quite a handy little tool and will be useful for any engraving jobs in the future. For dividing into degrees a division plate being a multiple of 9 will be necessary. One of my standard plates has 27 notches, so that each three will give 1 deg. on the work. Use the machined straight edge as a "zero" and mark in degrees making each fifth one a little longer and each tenth one right across. For this job it is not necessary to run the machine under power. The cut is so light—only 3 or 4 thou., that rotating the driving pulley with one finger is quite sufficient. Engrave each side in turn up to 90 deg., and then number each tenth division with small number punches. I find the punches, now on the market, made by a typewriter firm are excellent for this class of work as they can be got down to 1/32 in. high.



The dividing-head after engraving

Well, that completes the work on the machine and the only other question to be dealt with is that of powering it. I have tried out several schemes including one to make it entirely self-contained. This can be done, but in view of the vertical and swivelling movements of the spindle, so many jockey pulleys were necessary that the result was cumbrous and unsightly. The simplest method and the one which I recommend is a direct drive to the driving pulley from a separate motor or motor unit. In practice both the machine and the motor are screwed down to a



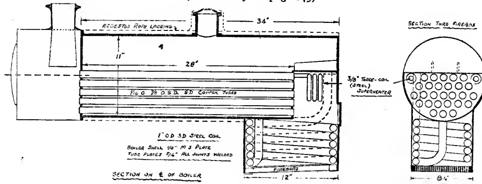
Home-made engraving cutter

flat bench top and the drive is transmitted by a ½-in. round leather belt. When cutting spirals, and the swinging arm is accordingly at an angle, it simply means that the machine and motor are screwed down to the bench top at the requisite angle to one another. This arrangement is shown in one of the photographs. By the way, the motor unit shown is one used to drive a small precision lathe. It incorporates a clutch/brake and gives a wide range of speeds so that it is ideal for the job. For very light work it is not necessary to power the machine at all. Engraving and the cutting of clock gears in brass can be carried out quite conveniently by means of a handle fitted to the driving pulley.

With regard to finish, flat machined surfaces look best, to my mind, scraped and "frosted" and a few coats of dark grey cellulose enamel applied with a brush to the unmachined portions of the castings give that final "finished" look to the machine. As mentioned before, these notes have described the machine as constructed by myself. I do hope, however, that any readers undertaking its construction will not stick too slavishly to the design. There is room for improvement in everything, particularly so in this case, and I hope readers will apply their own ideas and ingenuity in that direction. As I believe, however, that some of the features of design are novel and capable of useful application to other mechanical appliances that the model engineer can make up for himself, I hope that some of the ideas involved will be found useful by those whose delight it is to make the tools to finish the job, and surely, model engineering can offer no greater satisfaction than this.

A Stayless 2-in. Scale Locomotive Boiler

(*Continued from page* 645)



new copper tubes were well under £10; the following fittings were re-used, consequently there was little further cost.

Cast-iron chimney and dome, two safety valves, whistle, two check-valves (one for pumps and one for injector), water and pressure-gauges, blower cock injector valve, regulators, blow-down valve, sliding fire-door, smokebox door, asbestos rope and external sheet-metal lagging, handrails, etc.

As will be seen from the photograph, the boiler externally in no way differs from the ordinary locomotive boiler, and in operation is perfect to handle, plenty of steam and light on fuel; the main trouble is keeping steam down below blowing-off point, 100 lb.

The total length of the engine and tender is just over 9 ft. and my circular track is about 450 ft. round.

If any of THE MODEL ENGINEER readers are genuinely interested, I extend an invitation to come and examine, test and drive the engine at any time, and I have no doubt as to the result. Any letters addressed to me c/o the Editor of THE MODEL ENGINEER will be forwarded, but don't forget a stamp if a reply is needed.

Familiar Workshop Terms

Some of the peculiar names that make up the engineer's vocabulary

by J. W. Tomlinson

ONE of the things that gives the young engineer more confidence than anything else is knowing the workshop terms of the various tools and machine parts that he has to handle. If he has the ability to call the parts by their workshop names, he can talk much more easily with his fellow workmates and they in turn know just what he is talking about.

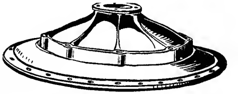


Fig. 1. *A supercharger casing that was named a "dustbin lid"*

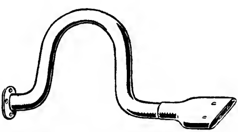


Fig. 3. *A "swan's neck" fitted with a "fishtail"*

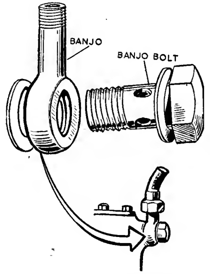


Fig. 2. *A "banjo" and "banjo" bolt used for oil and fuel connections*

When a new part is designed, the draughtsman generally has the job of naming it, and if it is a simple casing, it is most likely called a casing, with its appropriate prefix such as, oil pump front casing, or crankcase lower casing. The draughtsman will gradually build up his list of parts, and it is from these lists that the parts are usually known throughout the workshop.

A "Dustbin" Lid

However, parts which take on a definite shape, very often lose their drawing office name and are called by the name of something they resemble in other spheres of life. This is quite understandable, as the man in the workshop does not always have access to the list of parts, so when he sees a thing and does not know its name, he calls it by the name of something he does know. A rather flagrant example I have in mind, was, during the war years, when all types of people were drafted into the workshops, a supercharger casing came to be called a "dustbin lid." This is quite understandable, if one takes a glance at the casing as sketched in Fig. 1. If you talked to a chap about "dustbin lids," he knew at once what you were talking about, so from the foreman to the errand boy, they were known as "dustbin lids."

Now from this observation, it is not suggested that the young engineer should go around naming things, but if he sees parts that look familiar, the shape of them is often (but not always) a clue to their workshop name. While some names are strictly engineering terms, there are others which have originated by their resemblance to something else, and since the only way of recognising by seeing, is by comparison, this seems quite a good scheme. It is hardly possible that things named by engineers in such a way, will get mistaken for the thing they originally represented. For instance, if a chap went to the works stores for some fish-tails, nothing short of a practical joke would prevent him getting the right kind.

To Which Branch ?

There is one shortcoming to this scheme, that is, it should be understood to which branch

of engineering the term is being applied. For instance, a "dolly" in civil engineering is an object interposed between the "monkey" of a pile-driver and the head of the pile, to prevent damage to the latter by the former. In electrical engineering, it is the operating member of a tumbler switch, and in general engineering, it is a heavy tool shaped like a hammer for supporting the head of a rivet while a head is formed on the other end. It has yet another meaning in mining engineering, where it takes the shape of a counter-balance weight used in a hoisting shaft.

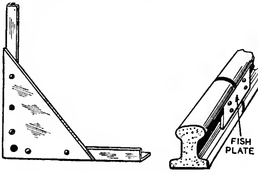


Fig. 4. A "gusset" for strengthening joints, and a "fish" plate for joining rails or girders

Some of these queer names offer no resemblance to shape, but there is often something that helps in recognising them. Take, for instance, the "monkey" I have just mentioned, as used on a pile driver. It is nothing like a monkey in shape, but it is taken up and down like a monkey on a stick. The point is this, that if one has to pick out something from a photograph, drawing, or a group of parts, if the name can give some idea as to what it looks like, it is a great help.

Some workshop names persist over the years until the part is known only by its workshop name and appears on the list of parts as such; this, of course, is what is meant by a "living language." As an instance, take the "banjo" connection, shown in Fig. 2. This type of connection is used on most oil and fuel systems. The oil or fuel passes along the pipe, around an internal groove in the banjo and through holes in the hollow banjo bolt. There is no mistaking the banjo shape in this instance.

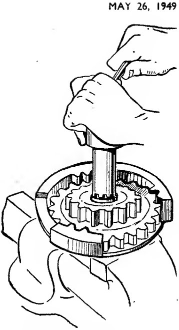


Fig. 6. Using a "dogging" tool to tighten a gear-retaining nut

Practical Examples

Hundreds of everyday things are familiarised in the workshops, ranging from musical instruments to animals, and from fruit to insects, birds and fishes. Fig. 3 shows an exhaust pipe for an automobile bent to clear the rear axle, as is usual practice; this is called a "swan-neck," and the flattened-out piece at the end, as any keen motor

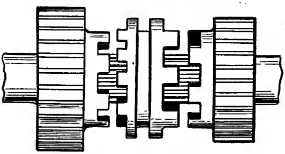


Fig. 5. A "dog" clutch with sliding member containing "dogs"

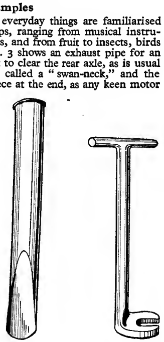


Fig. 7. A "cow mouth" chisel, and a "claw" spanner

cyclist knows, is called a " fish-tail." To continue with this fishy business, we have the " fished " joint shown in Fig. 4, where two girders or rails are joined by a " fish " plate each side. Then we have " gudgeon " pin, sometimes called, a wrist pin or piston pin. These two latter names are gaining popularity, no doubt through the origin of the old name being lost in antiquity.

Among the animal names is " dog." Sometimes a " dog " is a projection like a pawl, something that " grabs hold " like a dog. A dog-clutch is shown in Fig. 5, having projections or " dogs " for taking up the drive. Next to these in name association, are " dogging " tools. These also take hold of things, and they are generally used to hold one part against another while a subsequent operation is carried out, such as tightening a nut, see Fig. 6. Then there is the " cow-mouth " chisel, shown in Fig. 7. I suppose the chap who first made and named

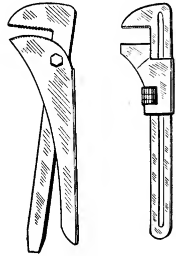


Fig. 8. A pair of " footprints " and a " monkey " wrench

one of these was really hard up for a name, although there is no mistaking the resemblance if one looks at a cow's mouth. The claw spanner shown in the same illustration certainly gives the impression of a claw, and it would be difficult, no doubt, to find a better name.

Most people know what a " monkey wrench " is, although I cannot see where the name comes from. Perhaps some reader can enlighten me. No doubt the lack of resemblance is the reason for it now taking on the more precise name of adjustable spanner. In my young days everybody called it a monkey wrench. " Footprints," shown in Fig. 8, is another well-known tool, and I think I am right in saying that " footprint " was originally a trade name. They certainly do leave their print on anything they have gripped, and for this reason they are almost shunned by high class engineers. A " spider " generally shows some resemblance to the creature after which it is named. In most cases it is round and has some form of legs. One example is shown in Fig. 9, where it takes the shape of a part for a flexible coupling as used in the transmission on automobiles. I have never seen a three-legged spider, but the resemblance in this case is sufficient for the uninitiated to " catch on."

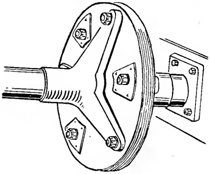


Fig. 9. A flexible coupling with a " spider " each side of the fabric disc

A small round file offers its own name and when anyone asks for a " rat-tail " file, there can be no misunderstanding. A " squirrel-cage " is not so easy, but when one is dealing with a particular type of machine there can be no mistake. For instance, the assembly shown in Fig. 10 is the intake guide vane assembly for a jet engine, and if someone referred to a " squirrel-cage " when working on jet engines there is only the one thing for it. Another well-known application of this term is in the armature of an a.c. induction motor, which consists of a number of axially-disposed conductors attached at the ends to solid rings or " spiders."

That Human Touch

As new machines are developed, this adoption of familiar names seems to give the machine that human touch that makes it part of a man's life. Even in this age of jets and rockets, the old everyday names continue to drift into the workshops. It was not long before the combustion chambers on a jet engine were known as " cans " in the shops, and in the R.A.F. It is much easier to say " cans," and a combustion chamber is more like a can than anything, and when all is

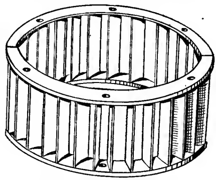


Fig. 10. The guide vane assembly for a jet engine called a " squirrel's " cage

said and done, it is made by a " tin basher," and he generally makes all kinds of cans. When one thinks of cascades, one generally pictures waterfalls and such like, but in the jet engine " cascades " are aerofoil dividers which split and divert the compressed air as it rushes through the outlet elbows of the compressor on its way to the " cans," see Fig. 11. " Banana " gauges are

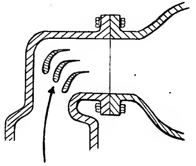


Fig. 11. *The aerofoil guides in a jet engine compressor are called " cascades "*

used for checking the throat area of the turbine nozzles, see Fig. 12.

Mixture of Names

And so it goes on, this mixture of names, some officially approved and some strictly workshop. Those names that persist, gradually take up their new meaning in our language, graduating from the shops to the list of parts. Then they start to appear in the technical dictionaries and eventually in the standard dictionaries. " Monkey " is one instance where this has happened, and its engineering meaning is given in most standard dictionaries of today. " Gudgeon pin " is also given (see Fig. 13). It is described as a clamp on which a rudder turns, which gives a clue to its origin.

Shop Names

To continue with a few more shop names, there is the type of file called the " knife " file because it is shaped like a knife, the " cheese-head " screw with a head like a cheese, and the " half-moon " spanner with its big curve like half a moon. The " C " spanner in the form of a C, and the humble " grub " screw that buries itself in the job like a grub in an apple, and the " skeleton " key, thin like a skeleton. A gusset used to be a tailoring term, now it can mean in engineering a piece of angle iron to strengthen a joint (see Fig. 4). A " pigtail " as used in engineering, is a short piece of plaited wire connecting the brushes on an electric motor. A slinging " eye " speaks for itself, and so does the " rag " bolt used for holding down machinery (see Fig. 14). Even the textile industry has its fancy names, a " candlestick " is the jet holder in a spinning machine, and a " letter box " is a flap at the bottom of the machine that the spinner lifts to withdraw the strand of silk.

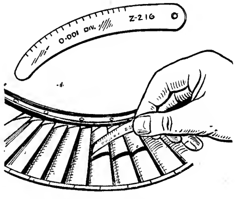


Fig. 12. *A " banana " gauge for checking the space between turbine blades*

It can be very embarrassing for the young engineer if he has to refer to a certain part as that " what you call it," especially if he is talking to his superior. Knowing the right names often saves a lot of explaining and eliminates misunderstanding. Although a lot of these fancy names are not recognised by some people, if they are not used by oneself, they should be known in order to understand any other chap who is using them, and it is hoped that the examples given in this article show the reader the course to take when finding out names.

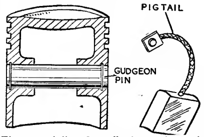
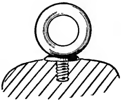


Fig. 13. *A " gudgeon " pin or piston pin, and a " pigtail " for connecting an electric motor brush*



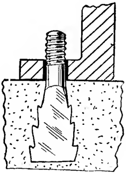


Fig. 14. *A slinging " eye " for lifting heavy components and a " rag " bolt for holding down heavy machines*

PRACTICAL LETTERS

Fowler Engine No. 20223

DEAR SIR,—Referring to your issue of April 14th, I can supply the information wanted by Mr. Birkby regarding traction engine *Supreme*, John Fowler's No. 20223.

It is pleasing to note that this is still working but minus dynamo and extended canopy, being used for road haulage of locomotives, boilers, etc., to the docks here. It is run by Road Engines and Kerr, of Glasgow, who also have two Burrell 15T engines on this work.

I trust this will be of interest to your readers generally and have pleasure in putting my records to some use. By the way, this was among the last showman's engines supplied by Messrs. Fowler.

Yours faithfully,

Glasgow. JOHN S. BROWNLIE (B.Sc.).

Amateur Car Construction

DEAR SIR,—I was very interested indeed by Mr. J. H. Ahern's letter of February 24th, as I have been building a small car to take two people, during the last 14 months. My power unit is an early 250 c.c. side-valve A.J.S. engine and gearbox cut from the motor-cycle frame in one built-up unit (price 10s.), incidentally all in good condition. Compression is excellent, and after decarbonising and general look round, it starts *first* kick. My two main chassis members are 1¼-in. × 1¼-in. × ¼-in. angle iron. There are four road springs 1¼ in. × 2 ft. long, anchored as in car practice with rear moving shackles. The front axle is an old Austin 7 cut and shortened to 30 in. width between the wheels; my rear axle is 1⅛ in. M.S. (axle steel from a car carden shaft) running in roller-bearings with ball-thrust races for side thrust, which will be considerable on this, as it is a fixed or solid back axle. The final drive is by way of four V-belts, ⅝ in. diam., and the rear sprocket of the motor-cycle is mounted on an adjustable cross shaft (running in ball-races too), and also carries the two 3½ in. double groove V-pulleys which, in turn, drive two 7-in. D.Gr. pulleys on the rear axle. Between these two on the rear axle, there is an 8-in. drum with a most effective band brake, which is the foot-brake, the hand brake being worked on the two Austin brake-drums and shoes on the front axle. The clutch is foot-operated by rods, and there is a foot-operated accelerator plus hand throttle, exhaust left, advance and return ignition, etc. Twin fans, one either side of the cylinder, take care of the cooling when either stationary or using the lower gears; they are driven by a small V-belt from engine shock-absorber. The gear lever and gate are left-hand change, hand brake on right. Wheels are 16-in. × 4-in. pneumatic wheelbarrow wheels (incidentally, the dearest part to buy). A Smith's cycle speedometer is being fitted, using a flat belt drive off the rear axle to turn a pulley and shaft carrying the existing cycle drive all in the correct ratio, which will make my 16-in. tyres register correctly. It's a case of working it out—16 in. and 26 in. in decimals.

The steering is an old Morris Minor column (a present—to get it out of the way) and hand wheel. The body is built up of ½-in. × ½-in. B.M. steel mostly, and 22 - gauge galvanised iron. The seats are one behind the other, the rear being in the form of a dickey-seat, which closes down when not in use. Cruising speed, according to calculations, should be about 30 m.p.h. with a maximum of 40 m.p.h. I hope to finish this within the next two months, as I think I've overcome most of the snags of building a machine without a blueprint by now.

Before this job I spent five years building a 2 in. scale traction engine without a blueprint from start to finish, all my own ideas, etc. Maybe I'll write about it one day to encourage other amateurs like myself. The whole secret of these jobs is *patience*—by one who knows.

Yours faithfully,

Broadstone. CECIL R. BUDGELL.

DEAR SIR,—In answer to Mr. Roffe's query, April 14th issue, I am building my second Austin Seven conversion. The first was built in 1938 and was broken up in 1946, having been used continuously during the war years. The car, made in 1931, was suffering from old age, but the body was sound. Incidentally, the original engine is still running in another car, and has not yet been rebored. A new set of rings have been fitted and oil consumption is very little. Not bad going, 1931-1949!

The present car is a complete rebuild from scratch. A 1933 saloon was secured, during the war, completely stripped and the parts wanted stored. Last year I managed to secure an Ulster dropped front axle and inverted spring, and after having the rear springs straightened, this lowered the chassis by about 6 in. A new two-seater body has been built, the floor being ⅝-in. ply-wood and the superstructure constructed of well-seasoned ¾-in. deal. This is covered with 3/64-in. aircraft ply and will be covered with rexine and enamelled as the 1938 car. The bonnet is aluminium sheet, and the radiator shell given a slight slope. The steering wheel is raked and the total overall height 2 ft. 10 in.

No special tools are required. The usual model engineer's kit and a few essential carpenter's tools are all that are necessary. But, there are a few snags in rebuilding Austin Sevens, the main trouble being the "A"-shaped frame and lack of support at the rear of the chassis. However, there is not much difficulty, provided a little thought is given to ways and means. One other important detail, a design may look good on paper, but when viewed in perspective, the result shouts "home made." It is best to make a solid model, about 1 in. scale, and view this from all angles, altering this till it satisfies. Some may not agree with wooden coachwork, but I prefer it for lightness and ease of construction.

I should be pleased to elaborate this or,

although the car is not quite finished, demonstrate same to anyone interested in building a body and pass on some hints.

Yours faithfully,
Orpington. H. R. WILCOXON.

The "Eureka" Clock

DEAR SIR,—It seems to me that there are at least three difficulties about this form of construction that might "scare off" many a would-be constructor.

(1) *The bi-metal balance rim*. This difficulty could be "evaded" by using a "plain" balance in conjunction with some form of "compensated curb" as mentioned by Mr. S. C. Cowper-Essex in Practical Letters, March 17th. Perhaps he could write again giving some constructional details.

(2) *The bearings*. If the balance is placed in a horizontal position in the clock, brass bearing would do, in this case the rounded end of the "foot" pivot could run on a piece of glass (endstone).

(3) *The gearing*. If worm drive is used, then an ordinary alarm clock would provide all the gears necessary (besides the 12-1 gear) the "great" and "centre" wheels are usually of 54 teeth each—turning off tops of teeth of one of these, and a few strokes with a fine file, would soon convert it into a ratchet wheel, which could be suitably mounted on an ordinary wood screw (properly pivoted, of course) to act as a worm drive to the other 54-toothed wheel mounted on the centre arbor, the ratio being 48.6 ("Eureka" 45), I think also, that this little bit of "speeding up" would be beneficial. A little adjustment of the hairspring and/or balance-screw weights would soon bring things out right.

With reference to the letter from Mr. A. E. Bowyer-Lowe—April 7th issue—regarding difficulty in obtaining suitable hairsprings. I think that, perhaps, the size of mainsprings fitted to the light (not the "two inch") type of alarm clock, particularly the "silent-tick" kind, might do, they are perhaps a little thinner than that specified, but also wider (thickness 0.015 in. never found in a watch). Don't forget that these spring strengths are calculated by the cube of their thickness (twice the thickness being eight times the strength).

I trust that these "simplifying" (?) remarks may encourage some to "try their hand" who otherwise might be "scared off."

Now the question arises—When is a "Eureka" not a "Eureka"?

Yours faithfully,
Portstewart. JAMES A. RITCHIE.

DEAR SIR,—May I thank "Artificer" for his articles on the above subject? For over a year I have had one of these most interesting clocks going, but not keeping anything like time, and a small adjustment suggested in the first article has produced a moderate time-keeper.

My model, which is intact, differs only slightly in detail from the published description. The clock must have seen a good deal of use, since the cam on the balance wheel spindle is deeply grooved by the roller and the latter shows fair signs of wear. The pawl is also well worn.

The essential adjustment—and I speak from long and somewhat bitter experience—is to get the electro-magnet on the balance wheel vertical, by loosening the set-screw fixing the hairspring to the balance wheel spindle and setting the wheel. Thereafter only minor adjustments are needed.

One point to be kept in mind is that this clock is affected by the earth's magnetic field. When the battery begins to run down, the clock will run facing north-south but not facing east-west. Current consumption is negligible.

Yours faithfully,
Spilsby. DR. C. E. FRISKNEY.

Legal Liability and Passenger Tracks

DEAR SIR,—I read the article by "Lex" in THE MODEL ENGINEER of April 28th with great interest.

The question of liability and claims in the event of accident on the track have been seriously considered by the committee of the Birmingham Society of Model Engineers Ltd.

As yet, the track has not been opened to the public, being confined to "licensees," and, as far as I know, there is no suggestion that it should. Nevertheless, a considerable number of persons who are not members have ridden on it, without accident.

The committee, on the recommendations of their architects and surveyors (both members), have endeavoured to make the track as safe and foolproof as possible, and it has proved so, so far. But, there is no knowing of what *may* happen.

In order to take every possible precaution, a track sub-committee of five has been appointed, and their responsibility is to pass (once and for all) every locomotive which is to run. Thereupon, a certificate of worthiness is issued to the member and a duplicate kept. This applies to locomotives built before December 31st, 1948. In addition, the boilers of locomotives built after this date are required to be submitted for a hydraulic test of double working pressure, registered by a master gauge, to be maintained for 20 minutes (fittings to be removed and blanked off). Further, on all special occasions and organised running days, a track steward is in charge, and his word is law. He is appointed for the particular day only, and is *any* member competent and willing to act. This does not apply at any time other than special days.

These matters have been incorporated in the insurance policy taken out by the society and form part of the terms of insurance, but running visitors are excluded from the tests whilst being included in the policy.

As you may imagine, the committee have been somewhat unpopular with some of the members who are unable to see the necessity for rules, regulations and by-laws.

It will be interesting, if you feel disposed to publish them, to read of the action taken in this matter by other societies.

For my part, I welcome the article, and hope that it will be read and digested by all members of the Birmingham Society of Model Engineers Ltd.

Yours faithfully,
Birmingham. W. H. KESTERTON.
Hon. Sec.